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The Tech
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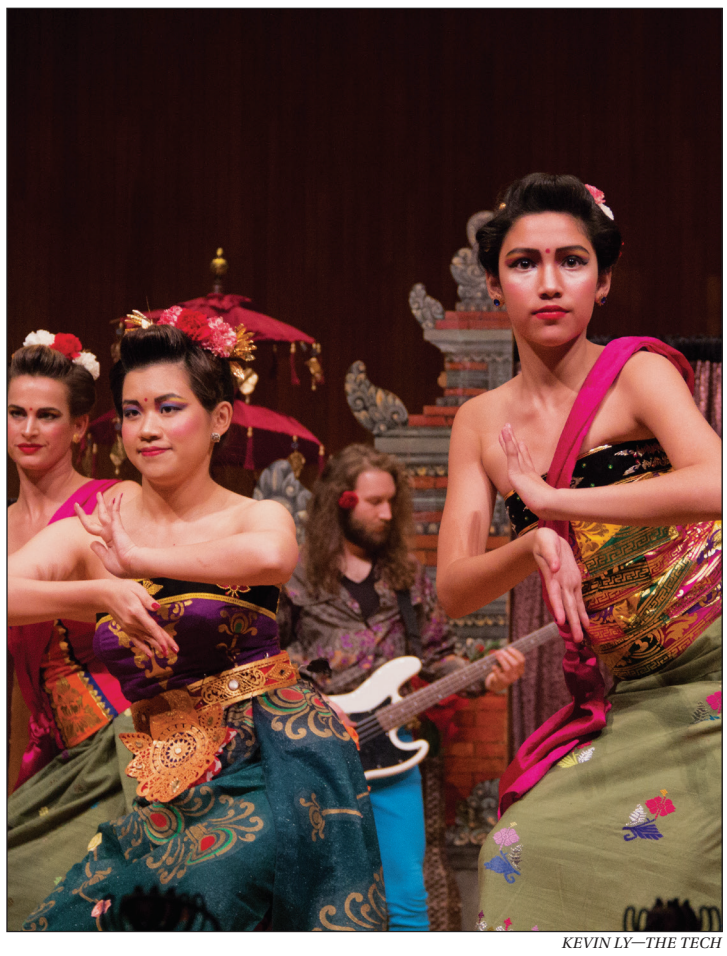
WEATHER, p. 2
THU: 40°F | 31°F
Partly Cloudy
FRI: 38°F | 18°F
Sunny
SAT: 29°F | 21°F
Sunny

Volume 138, Number 31

Thursday, December 06, 2018



KEVIN LY—THE TECH

Balinese dancers perform with the MIT Gamelan Galak Tika group, a Balinese percussion ensemble led by music professor Evan Ziporyn, in Kresge Auditorium Dec. 1.

Report recommends against terminating MIT-Saudi ties

Lester led reassessment following journalist's death

By Jessica Shi
NEWS EDITOR

Associate Provost Richard Lester PhD '80, who advises the administration on international activities, is recommending against the termination of any existing engagement with Saudi private or government-funded sponsors and organizations, according to a preliminary copy of his report emailed to *The Tech* Wednesday.

President L. Rafael Reif asked Lester to conduct a reassessment of MIT's Institute-level engagements with Saudi Arabia following the murder of journalist and dissident Jamal Khashoggi in the Saudi consulate in Istanbul. The reassessment was announced in a letter to the faculty Oct. 15.

The CIA has since concluded that Crown Prince Mohammed bin Salman, who visited MIT in March, ordered the killing of Khashoggi.

As of the publication of this article, Lester's report has been sent to the MIT community, and the contents are open for comment through mid-January. Then, Lester will summarize the feedback and forward it to Reif, who will make the final decision on how to proceed, Lester explained in an interview with *The Tech* Wednesday.

The recommendations highlighted three government and government-backed organizations that MIT has relationships with: the King Abdulaziz City for Science and Technology, a government agency with whom MIT founded the Center for Complex Engineering Systems; Saudi Aramco, a state-owned oil company and a founding member of the MIT Energy Initiative; and SABIC, a majority state-owned company and the sponsor of a yearlong research agreement with MIT signed during Mohammed bin Salman's visit.

There is no evidence to suggest that these organizations were involved in Khashoggi's murder, the report said, and they are unlikely to have any control over the Saudi government's repressive domestic policies or participation in the Yemeni civil war, two other issues acknowledged in the report.

The cessation of MIT's engagement would probably fail to have a "meaningful ameliorative effect" on those actions, the report continued.

If individual principal investigators do not wish to continue their projects with Saudi partners, MIT should work with them to "minimize the resulting disruption," especially to students, the report added.

The report also recommended against the termination of existing engagements with private Saudi donors and sponsors.

Additional opportunities for research or educational relationships with Saudi entities that may arise in the future should continue to be given consideration, as long as they comply with "MIT's policies and principles and relevant law and regulations," the report said.

The report recommended, however, that MIT refrain from "large overseas engagements" in Saudi Arabia until conditions there change significantly from the status quo, which the report described to

Saudi Arabia, Page 3

Michael Bloomberg to be class of 2019 commencement speaker

Former NYC mayor also the tenth richest man in the U.S.

By Emma Bingham
EDITOR IN CHIEF

Michael Bloomberg — entrepreneur, billionaire, and former New York City mayor — will speak at MIT's commencement ceremony June 7, 2019.

Bloomberg recently made a $1.8 billion donation to his alma mater, Johns Hopkins University, to support undergraduate financial aid.

He is part of the Giving Pledge, an organization founded by Bill and Melinda Gates and Warren Buffett that encourages billionaires to give away the majority of their wealth. According to Forbes, Bloomberg is America's 10th richest person.

Bloomberg served as mayor of New York City as both a Republican and an independent from 2002–2013, taking office a few months after the 9/11 attacks. Climate change, public health, and poverty were among his main priorities as mayor.

He remains active in the areas of climate change and global health. He currently serves as the U.N. Secretary General's Special Envoy for Climate Action, which, according to a U.N. press release, means Bloomberg "support[s] the Secretary-General's climate strategy and efforts towards the planned 2019 Climate Summit at United Nations Headquarters."

The release added that both Bloomberg and the U.N. Secretary-General believe that the emissions gap "needs to be closed soon to

Commencement , Page 3

COURTESY OF MARTHA DAVIS

The new MIT museum that will open in Kendall Square in 2021 will feature "The Exchange," a staircase that also functions as a space for short talks, film screenings, and more.

New music building to open in 2022

Building will be next to Kresge, construction to begin in 2020

By Jocasta Manasseh-Lewis
STAFF REPORTER

A recent gift from Joyce Linde, widow of Edward Linde '62, will fund the construction of a new music building adjacent to Kresge Auditorium.

Jon Alvarez, director of the Office of Campus Planning, wrote in an email to *The Tech* that the new building will include spaces for performance, practice, professional-level recording, research, and instruction, as well as a performance lab. It will incorporate acoustical design elements for optimal listening, playing, and recording.

The architect selection process is underway. Planning and design activities are expected to continue through 2019, with construction projected to begin in early 2020 and conclude in fall 2022.

MIT currently does not have a space dedicated to music performance; the music department shares spaces with other departments. Although Kresge Auditorium hosts many of the music department's ensemble rehearsals and performances, it was not designed for music performances and does not meet the needs of the music department and its ensembles. "A lot of high schools have better facilities than MIT dedicated just to music," according to Professor Marcus Thompson in an interview with *The Tech*.

The Music and Theater Arts website states that 5 to 10 students major in music (Course 21M or 21E/S) each year. It is one of the most popular minors and concentrations, with more than 1,500 students enrolled in music courses

Music, Page 3

IN SHORT

Course evaluations are now open and will remain open until 9 a.m. the first day of finals (Dec. 17).

The last day of classes is next Wednesday, Dec. 12. Good luck with your final projects and exams!

Remember to check your syllabi for **end-of-term violations of the rules of the faculty** and report any violations to the UA at violations@mit.edu or the chair of the faculty at exam-termregs@mit.edu.

There will be **blood drives in La Sala** on Dec. 10 and Dec. 12 from 1–6 p.m. and Dec. 11 from 8 a.m.–1 p.m.

Pre-registration for spring term is now open. The deadline to initiate pre-registration is Dec. 27 at 5 p.m. Pre-registration closes Jan. 17 at 5 p.m.

Send news and tips to *news@tech.mit.edu*.

MORE THAN MEETS THE MIND

Researchers hope to dispel stigma surrounding mental health conditions. **SCIENCE, p. 6**

FROM M&MS TO MRI

Ibrahim Cissé's path to biophysics. **SCIENCE, p.5**

TRASH TO TREASURE

Strut down the runway with plastic style. **ARTS, p.4**

WRITING CHILDREN'S STORIES

The formative years of Astrid Lindgren. **ARTS, p. 4**

MIT MUSEUM MOVE

The new building will be in Kendall Square. **NEWS, p. 3**

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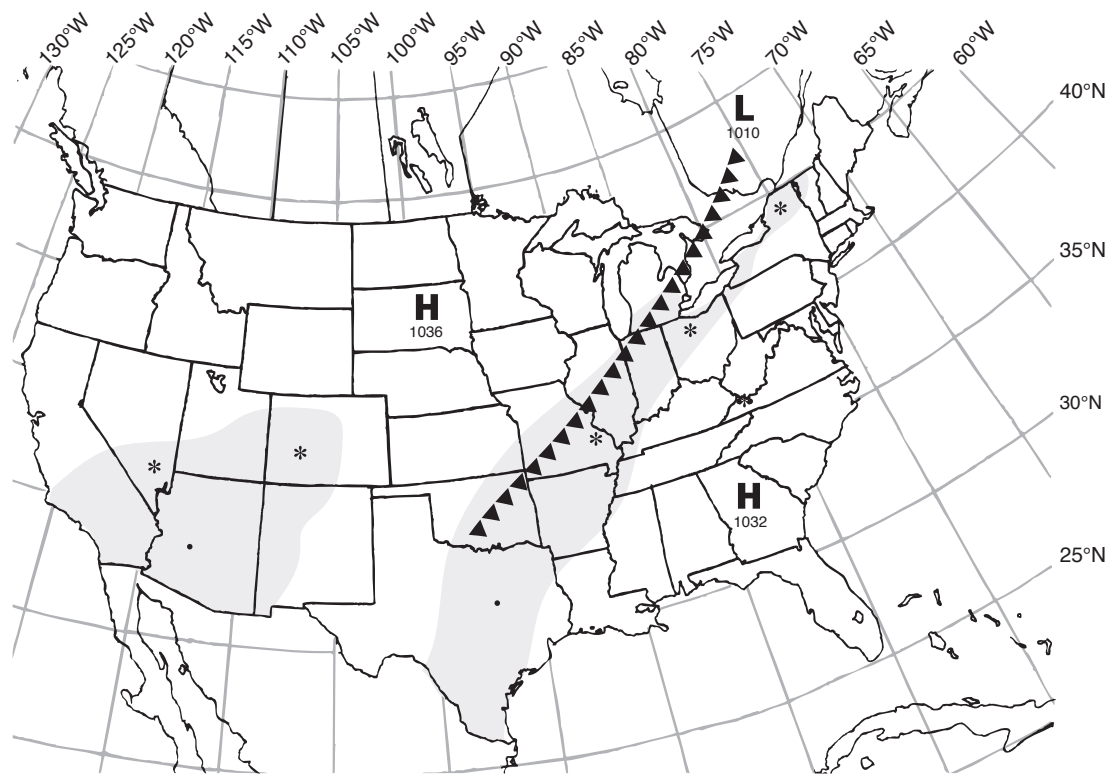
WEATHER

Finally, some lasting sunny and dry weather

By Jordan Benjamin
STAFF METEOROLOGIST

The dreary and wet fall is finally taking a long-awaited hiatus from perpetual deluge. If anytime over the past 3 months you felt the sun had deserted Boston and run off to frolic in the tropics, you weren't exactly wrong. September through November featured about 50 percent more cloudy days than normal. November was also the cloudiest since 1951, featuring overcast midday skies nearly 70 percent of the time. The persistent, record-breaking rains didn't improve things either. But finally we can at last put it all behind us and look forward to continued sunshine! This weekend will feature clear skies, cold air, and relatively light winds. If you can, take some time during this stressful period and enjoy it! Next week, we can look forward to continued calm weather, slightly above average temperatures, and below average precipitation. If you can't get enough of the clouds and rain (or snow), don't worry! They'll surely return soon, most likely late next week.

Looking beyond New England, the northern half of the U.S. will enjoy much of the same calm weather that Boston will as high pressure dominates. The mid-South and Southeast could see their first winter weather event of the season on Sunday as a low pressure system dumps snow into the Carolinas. California and the Pacific Northwest will continue to receive significant precipitation from a continuous a train of landfalling low pressure systems — a welcome respite from the disastrous and deadly fire season and what many hope will be the beginning of a wet winter that precludes more fires next year.



Situation for Noon Eastern Time, Thursday, December 06, 2018

Weather Systems	Weather Fronts	Precipitation Symbols			Other Symbols
			Snow	Rain	
H High Pressure	Trough	Showers	* ▽	• ▽	Fog
L Low Pressure	Warm Front	Light	*	•	Thunderstorm
§ Hurricane	Cold Front	Moderate	**	••	Haze
	Stationary Front	Heavy	⁂	∴	Compiled by MIT Meteorology Staff and *The Tech*

Extended Forecast
Today: Partly cloudy. High around 40°F (4°C). Winds west at 5-10 mph.
Tonight: Partly cloudy. Low around 31°F (-1°C). Winds SW at around 10 mph.
Tomorrow: Sunny. High around 38°F (3°C). Low around 18°F (-8°C). Winds W at 10-15 mph.
Saturday: Sunny. High around 29°F (-2°C). Low around 21°F (-6°C).
Sunday: Sunny. High around 36°F (2°C).

Chestnut and Sidney Street shooting Nov. 29 results in two arrests

Gunshots were fired in the area of Chestnut and Sidney Streets around 2:34 p.m. on Nov. 29. According to a statement by the Cambridge Police, two vehicles were spotted at the incident, one of which was a black sedan later stopped by the police.

Twenty-year-old Ladjuan Guichard and 23-year-old Joekeem Nelson were found in the sedan. Guichard was taken into custody and faces charges including armed assault to murder and carrying a firearm without a license. Nelson is being treated at a local hospital for non-life threatening injuries. His charges including armed assault to murder, reckless operation of a motor vehicle, and failure to stop for police.

A campus advisory email was sent out to the MIT community that afternoon by the MIT Emergency Management staff using information issued by the Cambridge Police Department. The Cambridge Police is in charge of the investigation. They are still looking for information about the other involved vehicle.

— Soomin Chun

MIT CHINA FORUM
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CHINA'S UNIVERSITIES IN PERSPECTIVE
THURSDAY, DECEMBER 6
11:30AM-1PM | MIT E52-164
LIGHT LUNCH PROVIDED
YINGYI QIAN: Former Dean, School of Economics and Management; Distinguished Professor of Arts, Humanities and Social Sciences, Tsinghua University.
Professor Qian wil outline the major in tiatives for China's universities in the past two decades, evaluate the major global rankings of :hese universities, anc will discuss future challenges of Chinese higher education.
MISTI
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MIT Museum to relocate to Kendall Square

New museum will occupy the first three floors of 314 Main St. and will open in 2021

By Sharon Chao
NEWS EDITOR

The MIT Museum will relocate to 314 Main Street in Kendall Square, between the MBTA Red Line Station and the Kendall Hotel. The new museum is projected to open to the public in late 2021.

314 Main Street is Site 5 of the Kendall Square Initiative, which consists of six sites being redeveloped for housing, retail, research and development, office, academic, and open space uses. The base building structure and core of the 17-floor building is currently under construction, according to Eric Höweler — a principal architect of the architectural firm in charge of redesigning the museum, Höweler + Yoon — in an email to *The Tech*.

The new museum will occupy part of the basement and ground floor, as well as all of the second and third floors. Other tenants of 314 Main Street will include the MIT Press Bookstore and the aerospace company Boeing, according to an article by MIT News in August 2018.

"The design and programming of [the new museum] has been approved and we are currently working on the documents that will be provided to the construction teams who will build the space," Howeler wrote.

The 57,000-square-foot museum will be organized in a spiral which will begin on the ground floor and wrap around the second and third floors via two sets of spiral staircases. The staircase between the second and third floor, called "The Exchange," will also serve as a space for gallery demonstrations, short talks, debates, film screenings, and more. It represents the significance of the museum as "a meeting ground for people from many different communities: MIT faculty and students, Kendall square entrepreneurs, Cambridge residents, visitors from around the world, and so on," John Durant, director of the MIT Museum, said.

The new museum will have a 300% increase in space for programmatic, face-to-face activities with visitors. This includes two classrooms for educational workshops and a makerspace. "Museums are as important for what you do in them as for what you see in them. Especially here at MIT, a place whose motto is *mens et manus*, people come here not just to see things but to do things as well," Durant said.

On the other hand, there will only be a modest increase in the amount of gallery space. "When you have large numbers of galleries, it becomes a burden because you have to renew them regularly," Durant said. "We didn't want so many galleries that renewing them would be an unrealistic burden."

There are already plans for some of the galleries. The first gallery that visitors will encounter, which will be on top of the staircase connected to the second floor, is a synoptic gallery introducing MIT. The last gallery on the third floor will be a collections gallery "designed to showcase a representative cross-section of all the museum's collections," Durant said. It will also include digital access to collections not on display.

In between the first and last galleries, there will be galleries about life sciences and technology and computing and artificial intelligence.

According to Durant, MIT determined the capital cost of the museum to be $111 million. The museum has to raise half of that amount. In addition, around $15 million is needed for other costs, such as specialist digital technologies and new websites. Lastly, the museum would like to increase its endowment by $30 million in order to help fund running costs. "The museum [currently] costs more to operate than we can earn. The new museum will be even more expensive to operate because it will be larger," Durant said.

Once the MIT Museum has moved into its new location in Kendall Square, it will retain 13,000 square feet of the original museum space for storage and management purposes. The museum is set to be completed in December 2020, but it will take six to seven months to fill it with galleries.

Faculty editorial calls for independent assessment

Saudi Arabia, from Page 1

include "cultural norms, laws, and policies" that are "biased against women, against certain religious groups, and against groups based on sexual orientation and gender identity."

A fifth recommendation affirmed that MIT welcomes Saudi students and researchers. Lester emphasized in the interview that part of his role is to ensure that Saudis on campus are valued and not subject to any type of discrimination or action against them.

"Appropriate Saudi visitors" will continue to be welcomed on campus as well, the report said.

Maher Mutreb, who is part of a group of Saudi agents identified as having played a leading role in Khashoggi's murder, would be an example of an unwelcome visitor, Lester said in the interview. Mutreb was part of Mohammed bin Salman's entourage during the latter's visit to MIT, and his presence on campus retrospectively feels like a "violation of our space," Lester said.

As for Mohammed bin Salman himself, Lester did not explicitly say when asked whether he would be unwelcome. "I think it's unlikely that he would be willing to come under the conditions that we would likely want to apply," Lester said. "But that's pure speculation."

Reflecting on the outcome of the reassessment, Lester said, "We've had for many years — decades even — collaborations with good people in Saudi Arabia who are trying to do good things. ... What this report says is that we should not walk away from these people despite the actions of people in their government."

Lester noted in his report that some have wondered why Khashoggi's death in particular triggered the reassessment when criticism of Saudi Arabia has been ongoing.

"One reason for conducting this review now is that MIT had previously been considering a significant expansion of our relationships with the Kingdom," the report said.

This was due to a view that Saudi Arabia was becoming more progressive, and thus expanding engagement might aid in this process positively. But Khashoggi's murder has "deflated many of those hopes," the report continued.

The particulars of this incident, namely the "brazenness, brutality, and contempt for international opinion" the Saudi government has exhibited, also contributed to its significance.

As part of his review, Lester sought input from a "broad range" of MIT faculty, student, staff, and alumni, according to the report.

Around 25 to 50 faculty members responded to his request for comment, Lester said in the interview. Lester also said he reached out to individuals who were likely to have views on the issue, such as faculty involved in relevant projects, Saudi students, and experts on the region.

The contents of these conversations are confidential, but several students and faculty members have made their opinions known through public channels in recent weeks.

Lester has "reported that MIT will investigate these agreements, certainly a necessary step, which should have been taken before the agreements were made," Professors Nazli Choucri, Jonathan King, and Nasser Rabbat wrote in an editorial in the November/December Issue of the faculty newsletter.

"However, having a committee constituted by the administration, to investigate the administration's actions, is clearly not adequate. We need a committee that is independent of the administration," the editorial continued.

More than twenty political science graduate students signed a letter to President Reif published in *The Tech* Oct. 25, which called for Reif to cut MIT's ties with Saudi Arabia.

"We recognize that the funding MIT receives from Saudi Arabia has been channeled towards serious and noble research projects here at MIT. We understand that if MIT were to speak out against human rights violations in Saudi Arabia, there may be financial retaliation," the letter said. "However, a renowned institution like MIT must not be threatened into silence."

Data on the financial scope of MIT's engagements with Saudi Arabia were considered over the course of the reassessment, Lester said, but financial considerations did not "loom large" over the recommendations.

According to the table included at the end of the report, sponsored research programs make up 52 percent of "current MIT activities enabled by Saudi collaborations and financial support."

Aramco, the largest funder in this category, has been contributing around $5 million a year for the last five years, which accounts for "somewhere between a half and a lot" of the total operating funding MIT receives from Saudi sources, Lester said. (Lester did not specify the exact percentages to respect the confidentiality of some gifts.)

Another 44 percent is labeled "gift-enabled activities." This includes the Jameel Poverty Action Lab, which is funded by the organization of Mohammed Abdul Latif Jameel '78, a Saudi businessman and philanthropist.

The amount of sponsored program funding MIT receives from Saudi Arabia represents a very small fraction of the Institute's total operating budget — less than 0.3 percent, Lester noted in an email to *The Tech*.

Bloomberg considering run for President in 2020

Commencement, from Page 1

limit global temperature increase to below 2°C."

Bloomberg also serves as the World Health Organization's Global Ambassador for Noncommunicable Diseases, a position he was appointed to in 2016. He has worked on tobacco control and injury prevention with the WHO.

He supported the Democratic Party during the 2018 midterm elections and is considering a run for President in 2020 as a Democrat. While he aligns with Democrats in his support for gun control and environmentalism, he has been criticized by some for his fiscally conservative views and his support of the stop-and-frisk tactic used by police during his mayoral term.

UA president Alexa Martin '19, GSC president Peter Su G, and 2019 class president Trevor McMichael '19 cited Bloomberg's commitments to philanthropy, entrepreneurship, and the environment as reasons they are pleased that he will address the Class of 2019.

"Mr. Bloomberg's entrepreneurial leadership and global activism will inspire our graduates as they seek to change the world," Martin told MIT News.

Bloomberg was born in Boston and raised in Medford. He graduated from Johns Hopkins in 1964 with a B.S. in electrical engineering and earned an MBA from Harvard in 1966.

He founded Bloomberg L.P., a finance and technology company, in 1981. The company's core revenue-generating product is the Bloomberg Terminal, a software that financial professionals use to trade, analyze financial markets data, and receive global financial news.

The company also has numerous media outlets, including a news agency, a global television network, magazines, and radio stations.

"As an engineer who started a tech company in the early days of the computer age, I'm looking forward to addressing this year's graduates as they begin their journeys," Bloomberg told MIT News.

Previous MIT commencement speakers include Facebook COO Sheryl Sandberg (2018), Apple CEO Tim Cook (2017), actor and filmmaker Matt Damon (2016), U.S. Chief Technology Officer Megan Smith '86 SM '88 (2015), DuPont CEO Ellen Kullman (2014), and Dropbox co-founder and CEO Drew Houston '05 (2013).

Music dept. may work with College of Computing

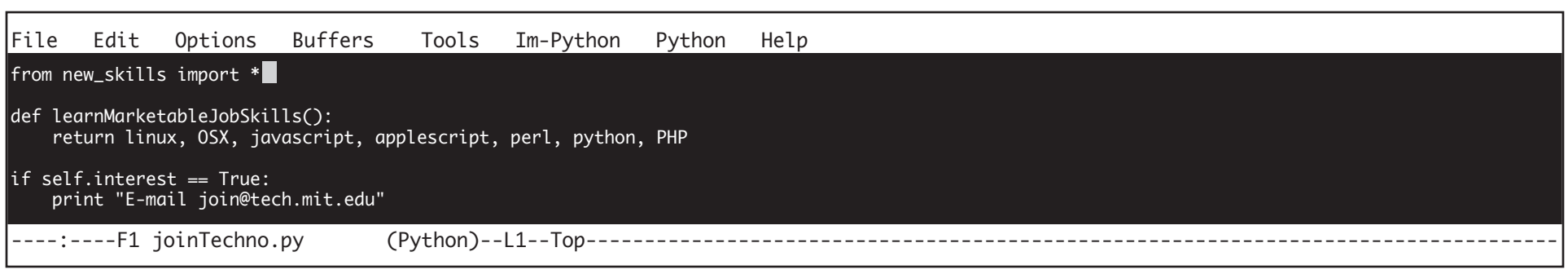
Music, from Page 1

each year.Thompson said, "I think that the Institute is finding out that we [Music and Theater Arts] have a lot more influence than they would have thought many years ago, in part because so many students have an interest in music."

"Especially for me, as a composer, being able to have access to a professional recording studio is really important," Audrey Pillsbury '19, a double major in Courses 5 and 21M, said in an interview with *The Tech*.

The first report that called for improved facilities for music and the performing arts was published in 1976, according to Keeril Makan, section head of Music and Theater Arts, in an email to *The Tech*. Pillsbury noted that one main complaint is that there aren't enough practice rooms. The new building will fill "a need that has long been recognized at MIT," Makan wrote.

In addition to the new building, Thompson said that the creation of the College of Computing might lead to a graduate program. "While this building is a boost to performance, the [College of Computing] is going to enable us to go farther in the direction of computational music. It's going to be a wonderful time."


File Edit Options Buffers Tools Im-Python Python Help
from new_skills import *
def learnMarketableJobSkills():
return linux, OSX, javascript, applescript, perl, python, PHP
if self.interest == True:
print "E-mail join@tech.mit.edu"
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ARTS ARTS ARTS

PROFILE

From analyzing M&Ms to illuminating cells

MIT biophysicist Ibrahim Cissé shares the story of his research career

By Aditi Saayujya

Ibrahim Cissé, Assistant Professor of Physics and principal investigator of Cissé Laboratory, has been interested in science for as long as he can remember — he was "very curious as a child, wanted to find out how things worked," and loved watching scientific Hollywood movies. As a young boy, he converted a storage room in his house into a laboratory, where he would tinker with electronics, taking things apart to build creations of his own.

Still, he never considered science as a possible career option. Growing up in Niger, science was not something he thought he could pursue. In fact, he expected to follow in his father's footsteps by becoming a lawyer. However, it was his long-cherished dream of coming to the United States that made it possible for him to study science.

Self-confessedly "very much into the pop culture at the time," Cissé was eager to come to the U.S., where "all the cool stuff was happening." He finished high school two years early by self-studying for and passing the National Baccalaureate exam as an independent candidate. Although the exam had no age restriction, he was nervous that his youth would draw questions, and recalls persuading his older brother to submit the application form for him.

Cissé's parents always encouraged him to pursue his interests — they happily surrendered their storage room and supported his drive to independently study for his exam. With the exam's low pass rate, however, they worried he wasn't mentally prepared for the possibility of failure. Assuring them that he wouldn't lose heart if his plans didn't work out, Cissé extracted a promise that they would let him study in the U.S if he passed. Soon enough, he cleared the exam on his first attempt and held them to their word.

Cissé had his first experience with research as an undergraduate at North Carolina Central University, studying the random packing of ellipsoids and determining how many contacts each ellipsoid made with its neighbours.

"It was actually experimental — we took M&M candies, poured the M&Ms in a jar, and tried to figure out how the geometry of the objects could help us understand the random packing density. We tried sophisticated approaches, like going to the local hospital and doing an MRI scan on the jar. To reconstruct it, you had all this computational need, and if you missed even a few M&Ms on the scan, it became tedious."

In the end, Cissé came up with a simple yet ingenious solution, "the type of thing one would come up with if you were a kid and you had your own lab." He poured thin paint into the jar of M&Ms, drained the paint, and counted the unpainted spots on each one to conclude that they made, on average, 10 contacts with their neighbours.

"I presented it to my professor, and he said, 'I don't believe it, I want to see it.' When I showed him the M&Ms covered in paint, he told me, 'You don't know what this means.' Although it was serendipitous for me, this was a problem that people had been trying to solve for some time. That was my first publication."

Cissé credits his PhD supervisor from the University of Illinois at Urbana-Champaign, Taekjip Ha, for introducing him to the field of single molecule bioimaging. Ha's research coupled distance-dependent intermolecular interactions to fluorescent beacons on the biomolecules, creating a "ruler to probe interactions within a few nanometers."

> **"We took M&M candies, poured the M&Ms in a jar, and tried to figure out how the geometry of the objects could help us understand the random packing density."**

"I emailed him and I said, 'I'm very fascinated by what I read on your website. Could I just come for the summer before grad school and try it out?' I went there that summer, and I never looked back. What's fascinating is that instead of looking at molecules in a test tube at the Avogadro number level, you can look at single molecules one at a time. Once I finished my PhD, I thought, rather than purifying the molecules outside cells, can we bring the microscopy inside cells?"

Cissé developed a technique to observe the movements of groups of biomolecules within a cell over time. "We put the molecules primarily in an off state, and give them a low probability of turning on. But if you do a small illumination, of very low power, a few of them will stochastically turn on, and start emitting another wavelength. And you control the emission intensity to make the molecule blink." By controlling groups of molecules before they can reach the 'on' state, he has been able to track their movements in super-resolution.

He has since used it to discover that RNA polymerase enzymes condense into short-lived clusters that seldom last for longer than eight seconds — far too short to carry out their function of producing messenger RNA, a process that takes several minutes. The clusters are made up of 80-100 RNA polymerases, which clump around gene loci during DNA transcription.

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Ibrahim Cissé hopes his research will shed light on processes that take place within living cells, such as protein aggregation.

> **"Once I finished my PhD, I thought, rather than purifying the molecules outside cells, can we bring the microscopy inside cells?"**

Prior to his discovery, scientists had believed that RNA polymerases were not involved in regulating gene expression — but in 2016, Cissé found evidence to prove otherwise.

"The clusters' lifespans were correlated with how many messenger RNAs [were produced]." He and his team soon found out that the clustering took place in order to load the polymerases on the DNA — a process that only needed a few seconds, after which they could "take their time" to produce messenger RNA. "The longer the cluster stays, the more polymerase can be loaded and more RNA comes out."

Today, his research group continues to work toward understanding how the clusters are formed and characterizing their physical properties. Cissé hopes his research will shed light on processes that take place within living cells and believes it can be applied to the diagnosis of neurodegenerative diseases such as ALS and Parkinson's Disease, which are characterized by protein aggregates that condense together like the RNA polymerase clusters. Cissé envisions a day when super-resolution microscopy will be able to detect these clusters long before brain imaging can, allowing patients to be diagnosed and treated early.

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FEATURE

Mental health and the brain

The science behind the stigma

By Jocelyn Shen and Quinn Brodsky
STAFF WRITERS

Research into the human brain has rapidly grown in the past few decades, and scientists and patients alike are beginning to understand the importance of mental health awareness. While there is much academic research being done to explore the complexity of the brain, practical applications and treatments remain imperfect. According to the National Institute for Mental Health, approximately 20 percent of the world is affected by brain disorders. At MIT, there are a number of groups dedicated to studying brain disorders specifically. Some labs focus on the genetic origins of neurological disorders, while others use imaging to predict and respond to indications of mental health conditions.

Guoping Feng at the McGovern Institute for Brain Research at MIT works on developing animal models of disorders such as obsessive compulsive disorder (OCD), autism, schizophrenia, and bipolar disorder. He studies the connections within the brain, called synapses, and explores how these circuits can correlate with mental disorders. His lab also researches how genetics can influence brain disorders. By studying genetic and environmental factors, his group can create useful animal models for these conditions.

Across the hall, at the Gabrieli Laboratory, John Gabrieli studies how the brain operates differently in people who have anxiety, depression, autism, or other brain issues using functional MRI, an imaging technique used to assess brain activity. Much of his research focuses on cognitive development in children and attempts to identify indicators of mental health issues so as to treat and prevent them early on. The group specifically seeks signs of susceptibility to anxiety, depression, and other mental health issues or learning disabilities so that in the future, children can be properly supported before they face serious struggles. The longer it takes to identify and treat a disorder, the less effective that treatment can be. Identifying features that might make someone prone to depression and anxiety would provide an opportunity to reach and support those who are vulnerable earlier rather than later.

Gabrieli's current research is now more relevant to the MIT community than ever. His new project, Boston Adolescent Neuroimaging of Depression and Anxiety (BANDA), is part of the Human Connectome Project (HCP), founded by the National Institutes of Health. The HCP is a collaborative project that compiles state-of-the-art brain measures to use over wide populations for effective analyses of various brain disorders. Gabrieli works with local hospitals including McLean Hospital, Massachusetts General Hospital, and Boston University to study adolescent anxiety and depression, using behavioral data and brain imaging to find differences in the brains of patients affected by the disorders.

The connections in the human brain can vary from person to person, and interpreting human brain images is a complex and involved process. While depression and anxiety are influenced by biological factors, the onset of these disorders is also affected by environment, family, and other outside influences that a researcher cannot study with an animal model. Animal models are often more useful to develop new treatments, but animal models for complex human experiences are flawed. "Humans are fantastically complicated," Gabrieli says, "which is amazing about people but terrible for research." It's hard to notice an onset of anxiety or depression in a mouse but very easy to see in a human. To Gabrieli, all of this speaks to the complexity and beauty of the human brain. "The brain's amazing biological capacity to substantiate the human experience — our wishes, our fears, our frustrations, our skills — it's amazing that a biological thing drives that."

Since Feng works primarily with animal models, he recognizes their limitations as well as their advantages. Although a mouse brain cannot replicate the complexity of a human brain, a mouse model can be successful in depicting monogenic disorders, disorders caused by a single gene. In Feng's field, some of the most successful animal models are monogenic models for certain cases of autism. However, monogenic conditions only represent approximately 10–30 percent of the autistic community, and most brain disorders are polygenic, corresponding to different combinations of genes. This is yet another complication that arises when studying the intricate and multifactorial influences that cause mental illness. These correlations are a huge challenge in studying mental disorders and demonstrate the sheer complexity of the brain. Brain disorders themselves are also known to have similar genetic profiles. For example, Feng describes how even though schizophrenia and autism are dissimilar in symptoms, they might still arise from mutations in the same genes. Furthermore, the contribution of environmental factors versus genetic factors in these conditions is still not well understood.

> **"The brain's amazing biological capacity to substantiate the human experience — our wishes, our fears, our frustrations, our skills — it's amazing that a biological thing drives that."**

While Feng uses animal models to elucidate the genetic factors behind brain conditions, Gabrieli uses functional MRI (fMRI) to assess the brain activity of humans with these conditions. He shows his patients some sort of stimulus like an image, and then looks for areas of the brain that exhibit increased or decreased activity. "A common stimulus for that is to show them things like faces that are happy or sad to provoke parts of the brain that respond to positive or negative experiences — or reward in depression, for example," Gabrieli explains. He often finds under-responsive reward centers in the brains of depressed patients, "which is perhaps part of the reason why a person finds life less happy, because few things are provoking a response from the reward mechanism that, in many people, is very powerful for everyday happiness." Within diagnostic categories, Gabrieli hopes to find individual differences in patients as different patients with the same diagnosis may respond very differently to the same drug.

Typically, medicated treatment of depression involves first giving a patient a treatment and seeing how they respond. If the treatment causes unwanted side effects or is not helpful to the patient, the practitioner prescribes something else. This process is semi-random — one type of medicine may only work for a third of patients, and there is no systematic way to see what medications will work for whom. Pharmaceutical companies market their products as being effective for the entire population of those with anxiety and depression, even though only a small fraction of the population responds. As a result, they conduct little to no research about the range of patients that any particular medication could treat. Many of these drugs were discovered by chance, and there has been little progress over the past 10 years in developing drugs that treat mental health conditions. This lack of advancement has to do with the complexity of disorders like depression and anxiety. Feng points out that diseases such as depression and anxiety cannot simply be attributed to genetics: there is so much we do not know about a person's life and their internal balance. Until more precise medications are developed, a prescriber's only option is to cycle through the existing drugs until one happens to work for the patient they are treating.

This is especially discouraging to patients with depression, whose struggle to find a compatible medication makes it less likely that they'll come back for subsequent appointments. "We have these labels like depression and anxiety or even labels like memory and attention for everybody, and they cover such a complicated range of actual things in people," Gabrieli says, noting the many individual differences in patients with the same disorder. Gabrieli uses brain imaging to tell who will respond to different kinds of treatments rather than directing them to one medicine without knowing if it will work for that particular patient. This is often termed "personalized" or "precision" medicine. "If you can know enough about a person beyond the diagnostic label, you might be able to steer them almost immediately to a treatment that's effective for them instead of having them try different treatments almost randomly now," Gabrieli says. "There is incredibly little evidence about which individual responds to which form of treatment." The idea is that getting data from a large range of individuals will help develop the database of behavioral and brain imaging so that it becomes possible to predict whether or not a patient will respond to medication.

For now, those who seek medication for anxiety or depression must contend with the struggle to find something that works. According to Gabrieli, "It's the nature of these disorders that it's easy to get defeated and not come back for more help." Clinicians cannot compel their patients to return, and many patients give up when they realize that no antidepressant is guaranteed to be compatible with them. Feng cites the current clinical environment as a contributor to the dearth of more specific and useful treatments. He notes that doctors are financially discouraged to see patients, and this causes many people in the field to focus solely on contributing to research rather than to therapy.

Nonetheless, research like Feng's and Gabrieli's has the potential to help patients understand their conditions. Those affected by mental health disorders are often blamed for their symptoms, especially ones that result in behaviors that are seen as socially unacceptable. If researchers are able to connect brain disorders to certain functional or genetic brain differences, patients are able to see that their symptoms are driven by something concrete. Gabrieli notes that this appears to be very liberating for the patient to understand why they feel the way they do.

> **"When your liver malfunctions, it might produce toxins. When the brain malfunctions, it produces abnormal behaviors. If you feel depressed, it is not something that you can simply snap out of."**

Feng reiterates this point as well. "If your neighbor has cancer or a heart attack, everyone will feel very sympathetic and likely visit, but say, if your neighbor has schizophrenia, people will stay away from them. However, these are the same things: they are both diseases afflicting certain organs, except in the case of mental disorders, this organ is the brain," he says. Feng also highlights how these stigmas differ across cultures. In Asian countries, for example, parents are generally more hesitant to admit that their child has a mental disorder. A study conducted in South Korea showed that on a phone interview, almost zero percent of families will admit that they have a child with autism. In comparison, this statistic amounted to approximately one percent in the United States. However, after conducting door-to-door interviews, the percentage of South Korean families who said they had autistic children was two percent. This study demonstrated how certain societal pressures can make people feel ashamed to admit that they have a mental disability. Across cultures, there are very different social environments that might prevent people from recognizing the importance of understanding mental disability.

Feng believes that a major misconception is that psychiatric disorders have no impact on the brain itself. Functional changes in the brain can happen and are happening, all the time; it is simply a matter of not being able to see these changes. "For example, when your liver malfunctions, it might produce toxins. When the brain malfunctions, it produces abnormal behaviors. If you feel depressed, it is not something that you can simply snap out of. So, the question is how do we help people understand that the brain is just like any other organ, but it's just much more complex?"

In addition to helping people understand that the brain is functionally changed by mental health conditions, Gabrieli stresses the importance of encouraging people to get help for themselves or for others. "Leaving a person in crisis is the least good thing you can do for yourself or for them," he says.

Gabrieli worries particularly about MIT students when it comes to the problem of asking for help. "I have this intuition that many MIT students got here by the strength of their motivation," he explains. "That same characteristic of a person that has made them fairly determined in certain ways can make them *not* seek help because maybe they would worry that it's a signal of weakness." Many students do use MIT Mental Health services — about a quarter of students use them by the time they graduate — but Gabrieli feels this is fewer than the number of people who actually need these services. Gabrieli thinks that if students knew how many of their peers used mental health services, they would understand that it is not at all a weakness — rather, a common problem — and would be encouraged to get help. Feng agrees. "It is really important particularly for young people to understand that they should not be ashamed," he says. "Just like your liver or your kidney can malfunction, your brain can as well. It is really important to tell this to younger generations, and it has been really encouraging to me that in the past few years, students have come up to me and told me when they are struggling. So I do think that the culture around mental health is changing in a good way."

Though cultural perspectives on mental health treatment are changing, healthcare infrastructure in the United States has yet to meet the needs of those suffering from mental health disorders. Feng notes that in the United States, there are simply not enough beds in inpatient treatment centers to host patients and not enough funding to study mental health conditions. Furthermore, most medical insurance policies do not cover testing for mental health disorders. This lack of resources and access to care demonstrates a need for changes in infrastructure and treatment. Feng argues that early diagnosis and prevention are crucial because the brain is plastic: there is still time to change a young brain. He believes that a combination of medicine and behavioral therapy can play a huge role in treating mental disorders from an early age.

According to Gabrieli, it is important to understand that the stigmatizing behaviors associated with disorders like anxiety and depression are out of a person's control. "It's not a voluntary issue; it's not a character flaw issue; it's a brain difference." Feng further emphasizes the difficulties that those suffering from mental health conditions face: "There is no suffering more painful than mental pain. It is really difficult for people who are not afflicted by these disorders to understand."

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Corgi

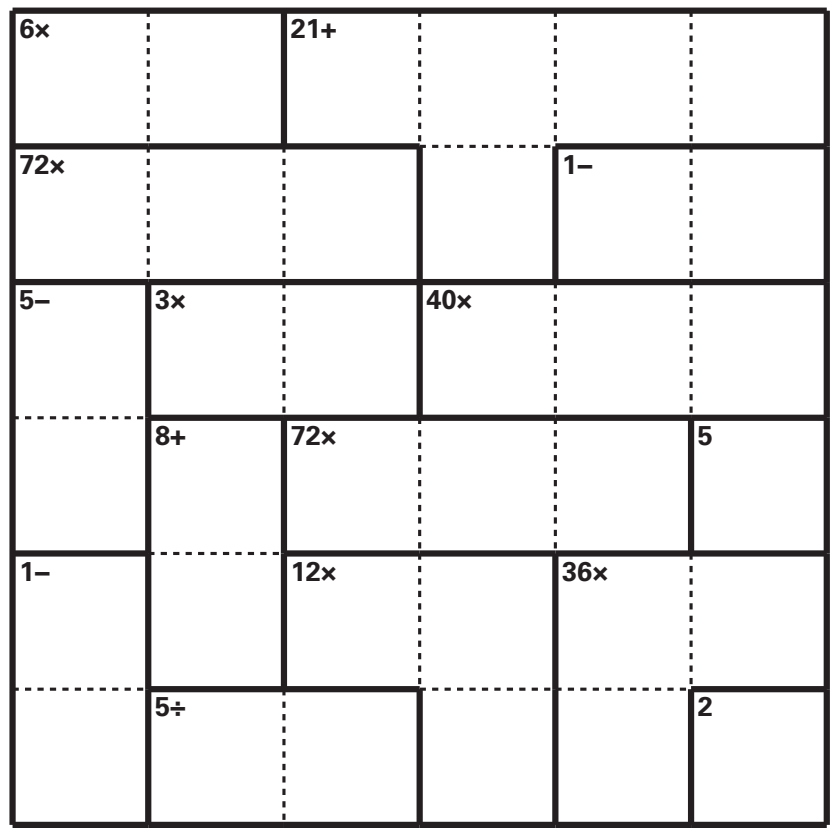
Solution, page 8

	8	1		2	3			
							8	3
		4		5	8	2		
3			8				2	
7		8		9		3		6
	2				7			4
		3	2	7		1		
6	7							
			5	3		6	7	

Instructions: Fill in the grid so that each column, row, and 3 by 3 grid contains exactly one of each of the digits 1 through 9.

Dachshund

Solution, page 8



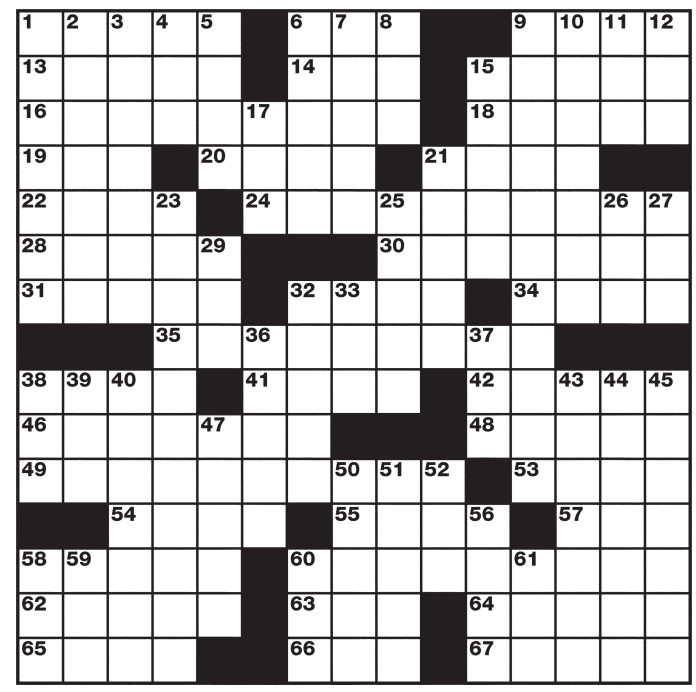
Instructions: Fill in the grid so that each column and row contains exactly one of each of the numbers 1–6. Follow the mathematical operations for each box.

HOLD 'EM by Greg Johnson

Solution, page 8

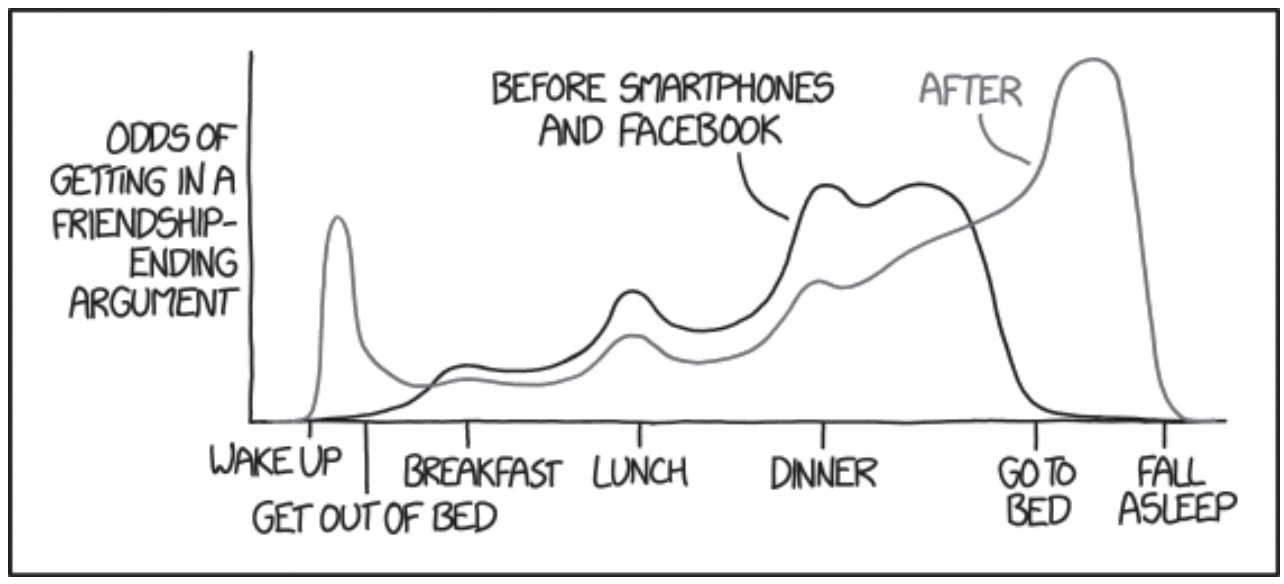
ACROSS
1 Catherine, in Chicago
6 2, on an ATM
9 Time to act
13 Mountaineer's device
14 Sound on MacDonald's farm
15 Threshold
16 Stick holder
18 Not from this world
19 Use for an old T-shirt
20 Bell-shaped flower
21 Idle drive
22 Hubbubs
24 Steak holder
28 Aristocratic one
30 Wonder Woman, for instance
31 Invitation to taste
32 Doubtless
34 Silver State sch.
35 Stock holder
38 Legal memo header
41 Scottish philosopher
42 Where bus patrons' trips start
46 Place for peas
48 Shelf hanger's tool
49 Stack holder
53 Monsieur Descartes
54 If __ the Zoo (Seuss book)
55 Future fiancé, perhaps
57 Ended a triathlon
58 Colorful image dot
60 Stalk holder
62 Potential pursuits
63 End of 34 Across' URL
64 Address an audience
65 Meet the Press host
66 Novelist Deighton
67 Mythical man-goat

DOWN
1 Highly lively
2 Land beside Peru
3 Allow to pass
4 Gym equipment
5 Stunt on skates
6 Relaxing walk
7 Sports show shout
8 A star of Friends
9 Place to buy pasta salad
10 Absorb, as scenery
11 Ice or Iron follower
12 Aching
15 Humidifier output
17 Monocle edge
21 Nod off
23 Part of a "greatest thing" comparison
25 Haiku's line count
26 Blow up: Abbr.
27 Clergy person, casually
29 Datum from a limo driver
32 Detailed examination
33 Einstein's birthplace
36 Metaphorical irritant
37 New U.S. arrival's class
38 Any of the Keys: Abbr.
39 Innovative, in Innsbruck
40 Gave a ballad a disco beat, say
43 Have more than one's fill
44 Gridiron punishment
45 Resembling a reed
47 Resonant sounds



50 Living quarters
51 Encore showing
52 Veep before Al
56 Sci-fi staples
58 Mining area
59 Certain affirmative answer
60 Obsolete sheet due to computer animation
61 Millennial's funds for the future

[1929] Argument Timing



Of course, everyone has their own profile. There are morning arguers, hangry arguers, meal-time arguers, late-night arguers, and people who get in a meta-argument over what their argument timing is, dredge up examples of past arguments, and end up fighting over THOSE again as well.

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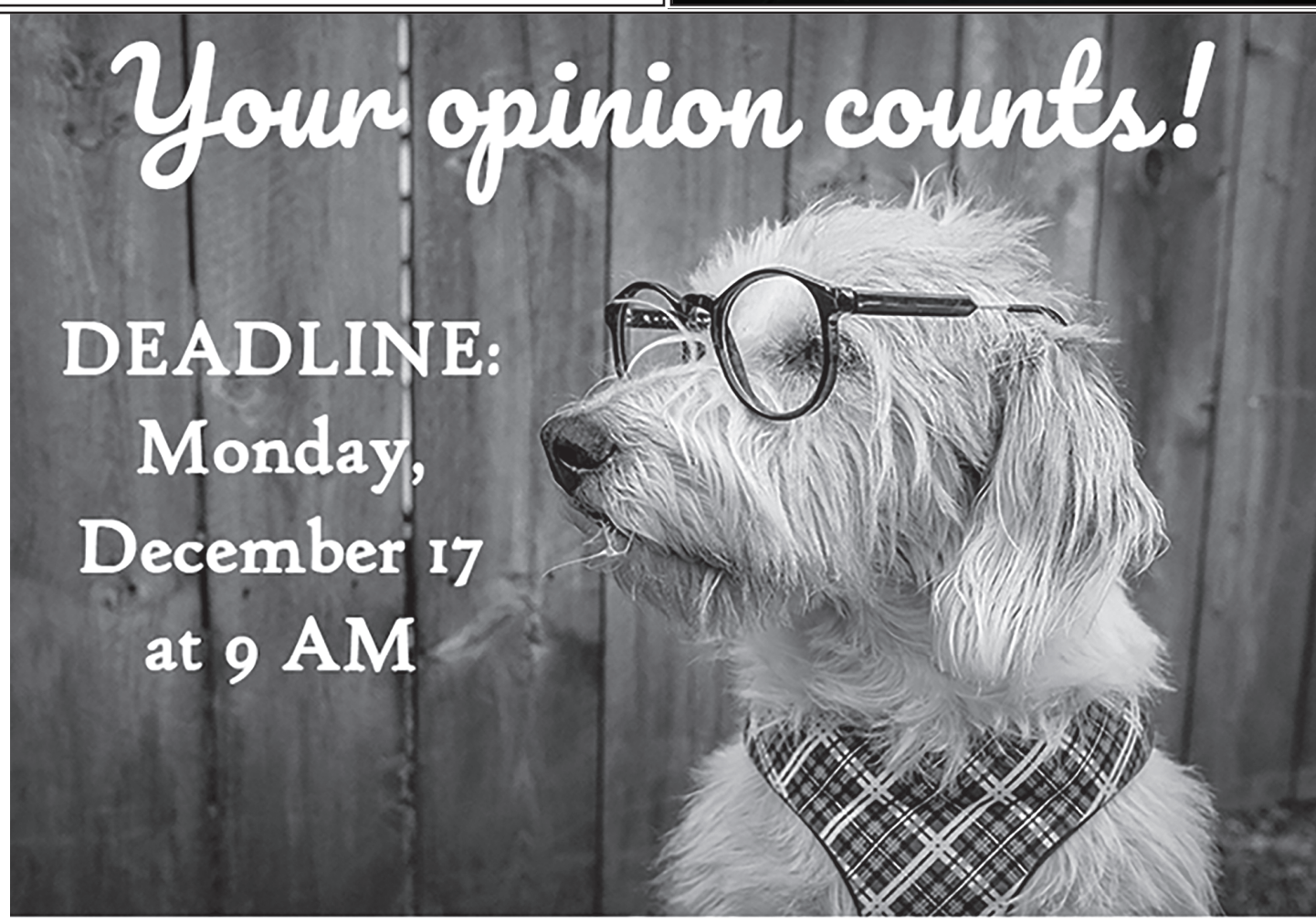

Solution to Corgi

from page 5

5	8	1	6	2	3	4	9	7
2	6	7	9	4	1	5	8	3
9	3	4	7	5	8	2	6	1
3	4	6	8	1	5	7	2	9
7	5	8	4	9	2	3	1	6
1	2	9	3	6	7	8	5	4
8	9	3	2	7	6	1	4	5
6	7	5	1	8	4	9	3	2
4	1	2	5	3	9	6	7	8

Solution to Dachshund

from page 5

2	3	5	4	1	6
3	4	6	5	2	1
6	1	3	2	5	4
1	2	4	3	6	5
5	6	2	1	4	3
4	5	1	6	3	2

Solution to Hold 'Em

from page 5

V	E	L	M	A		A	B	C			D	D	A	Y
I	C	E	A	X		M	O	O		V	E	R	G	E
B	U	T	T	E	R	B	O	X		A	L	I	E	N
R	A	G		L	I	L	Y		S	P	I	N		
A	D	O	S		M	E	A	T	L	O	C	K	E	R
N	O	B	L	E				H	E	R	O	I	N	E
T	R	Y	I	T		S	U	R	E		U	N	L	V
			C	A	T	T	L	E	P	E	N			
I	N	R	E		H	U	M	E		S	T	O	P	S
S	E	E	D	P	O	D				L	E	V	E	L
L	U	M	B	E	R	Y	A	R	D		R	E	N	E
		I	R	A	N		B	E	A	U		R	A	N
P	I	X	E	L		C	O	R	N	F	I	E	L	D
I	D	E	A	S		E	D	U		O	R	A	T	E
T	O	D	D			L	E	N		S	A	T	Y	R

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